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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

# WARTIME REPORT

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Memorandum Report

GENERALIZED SELECTION CHARTS FOR BOMBERS POWERED BY  
TWO, FOUR, AND SIX 3000-HORSEPOWER ENGINES

## I. CAPACITY AND ECONOMY

By Maurice J. Brevoort, George W. Stickle, and Paul R. Hill

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Langley Field, Va.

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MEMORANDUM REPORT

for the

Army Air Forces, Materiel Command

## GENERALIZED SELECTION CHARTS FOR BOMBERS POWERED BY

TWO, FOUR, AND SIX 3000-HORSEPOWER ENGINES

## I. CAPACITY AND ECONOMY

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## INTRODUCTION

This paper is a continuation of reference 1, which is a part of the study of the relationship of bomber parameters to bomber performance (references 2 and 3). The data of reference 1 are used to show the cargo which can be carried at various ranges and the pounds of cargo which can be carried per pound of fuel.

The assumptions, selected parameters, and equations applying to the original report apply without change to the supplement. All range performance figures are for the maximum lift-to-drag condition. It is also assumed that the gasoline and bombs are completely interchangeable. This assumption requires that part of the bomb load be distributed inside the wings for short-range operation if a design load factor of 4 is to be maintained.

The selection charts of the main report are reproduced in two parts in the supplement, and the power loading of the charts has been extended to 30 pounds per horsepower.

### USE OF SELECTION CHARTS

Performance selection charts are presented in figure 14. Part I gives the speed, the rate of climb, and the take-off distance. Part II gives the maximum range with no bomb load and gives the disposable load which includes the gasoline, oil, and bombs.

Figures 15(a), 15(b), and 15(c) show plots of cargo capacity (which is made up of gasoline, oil, and bombs) plotted against the range for bombers with several power loadings and a take-off distance of 4000 feet. These plots are made by graphical integration assuming that the cargo is carried one-half of the range. The end points for these curves are given in the selection charts. It may be seen that these curves are nearly straight lines for low power loading and they are slightly concave for high power loading. If the shape of these curves is observed, a good estimate of the curve of range versus cargo for any bomber on the selection chart may be drawn. By the use of these curves many interesting examples may be worked out in regard to cargo and economy for a given mission.

#### Cargo Capacity

By the use of the graphically integrated curves, such as those of figure 15, the curves (fig. 16(a), 16(b), 16(c), 17(a), 17(b), 17(c), 18(a), 18(b), and 18(c)) of constant cargo capacity for fixed ranges were drawn. These charts show

that the bomb capacity is almost entirely dependent upon the power loading. Wing loading has a small effect except at the lowest wing loadings where the bomb capacity suffers sharply.

It should be remembered that these airplanes are all calculated for a design load factor of 4 and when the gross weight is increased the structural weight is also increased to maintain this design load factor. This is mentioned to contrast it to the case of a given airplane's being overloaded by adding cargo directly. Such a procedure gives an even more rapid increase with power loading than is shown in the figures.

#### Economy

By the use of figures such as figure 15, the amount of bombs divided by the gasoline and oil may be computed. Figures 16(d), 16(e), 16(f), 17(d), 17(e), 17(f), 18(d), 18(e), and 18(f) are charts giving the ratio of bombs to gasoline and oil. This ratio attains importance when the supply problem becomes critical, as in the case of an air base obtaining its supplies by air transport. These charts are built on the assumption that the bombs and gasoline are interchangeable.

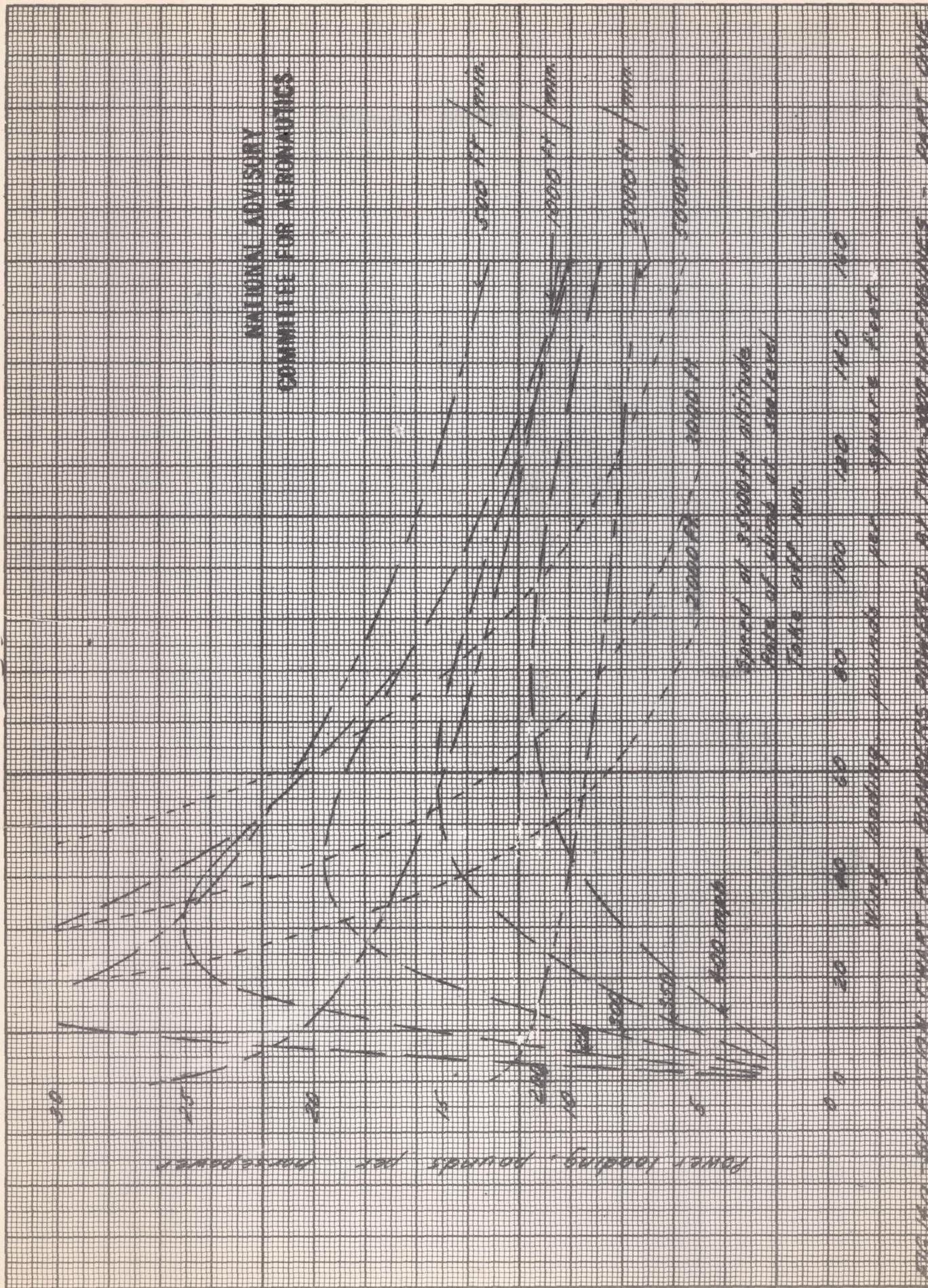
The importance of power loading is again shown by these charts and the effect of wing loading is more marked than on the cargo-capacity charts. In contrast to the cargo-capacity charts, there is an optimum power loading between 20 and

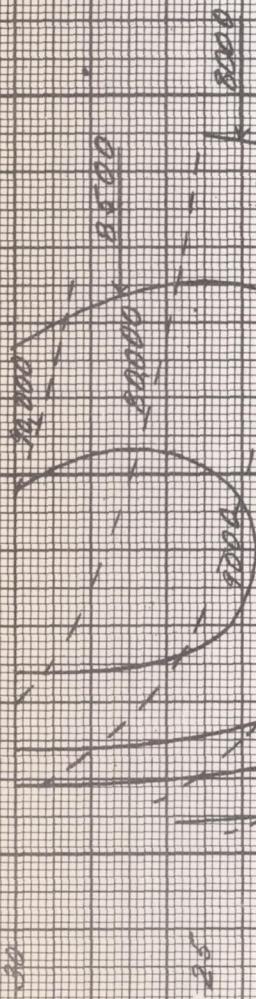
26 pounds per horsepower. The optimum wing loading for economy ranges from 40 to 65 pounds per square foot and is from 5 to 15 pounds per square foot higher than those found for the families of bombers powered by 2000-horsepower engines (reference 3).

Langley Memorial Aeronautical Laboratory,  
National Advisory Committee for Aeronautics,  
Langley Field, Va., January 30, 1943.

REFERENCES

1. Brevoort, Maurice J., Stickle, George W., and Hill, Paul R.: Generalized Selection Charts for Bombers Powered by Two, Four, and Six 3000-Horsepower Engines. NACA MR, Aug. 13, 1942.
2. Brevoort, M. J., Stickle, G. W., and Hill, Paul R.: Generalized Selection Charts for Bombers Powered by One, Two, Four, and Six 2000-Horsepower Engines. NACA MR, July 6, 1942.
3. Brevoort, Maurice J., Stickle, George W., and Hill, Paul R.: Generalized Selection Charts for Bombers Powered by One, Two, Four, and Six 2000-Horsepower Engines. I. Capacity and Economy. NACA MR, Sept. 19, 1942.

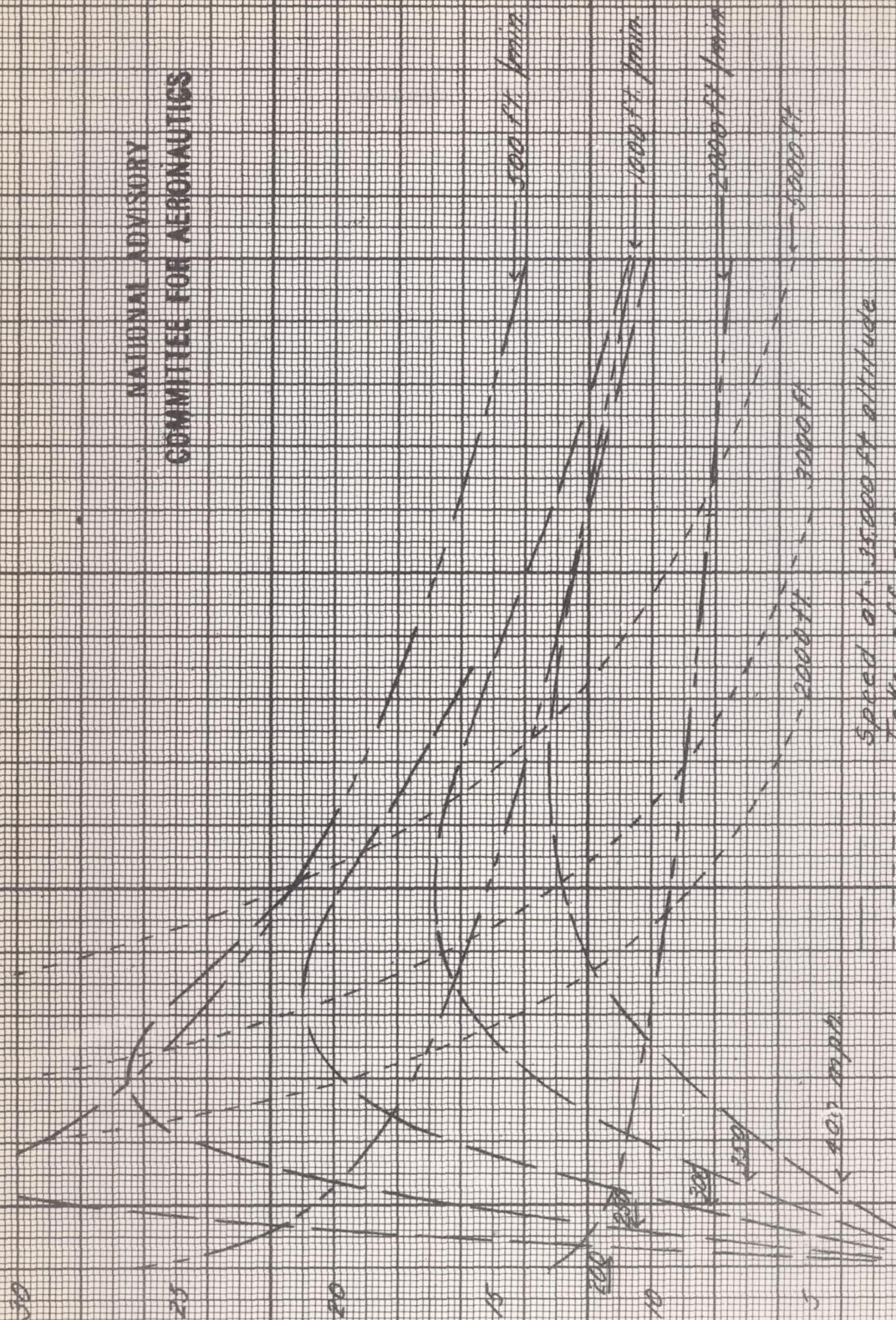


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POWER LOADING POUNDS PER HORSEPOWER

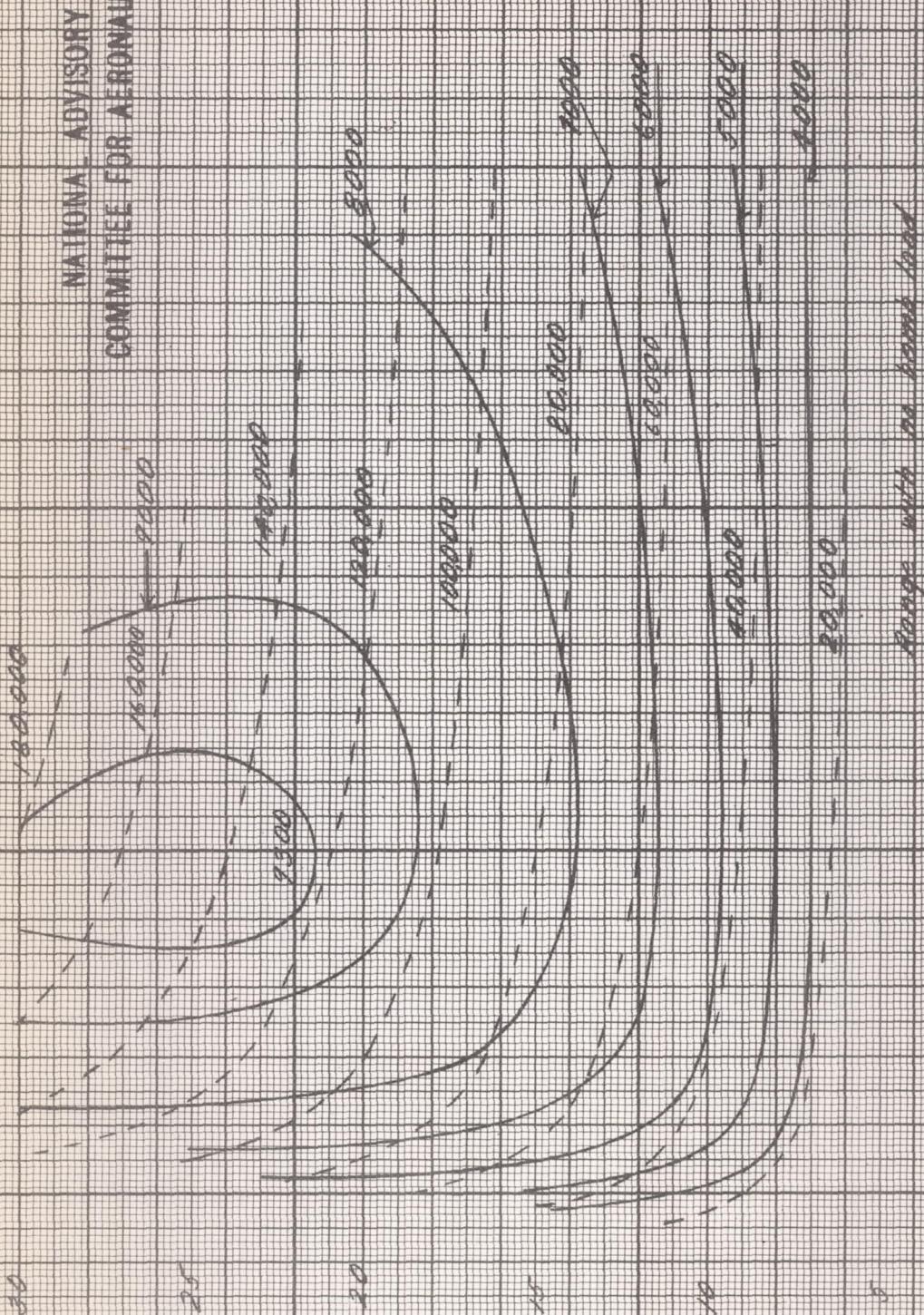
DISPLACEMENT 600 cu.in.  
1200 rpm same loadDISPLACEMENT 800 cu.in.  
1200 rpm same load  
using leading pounds per square foot

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Power Loading, pounds per horse power

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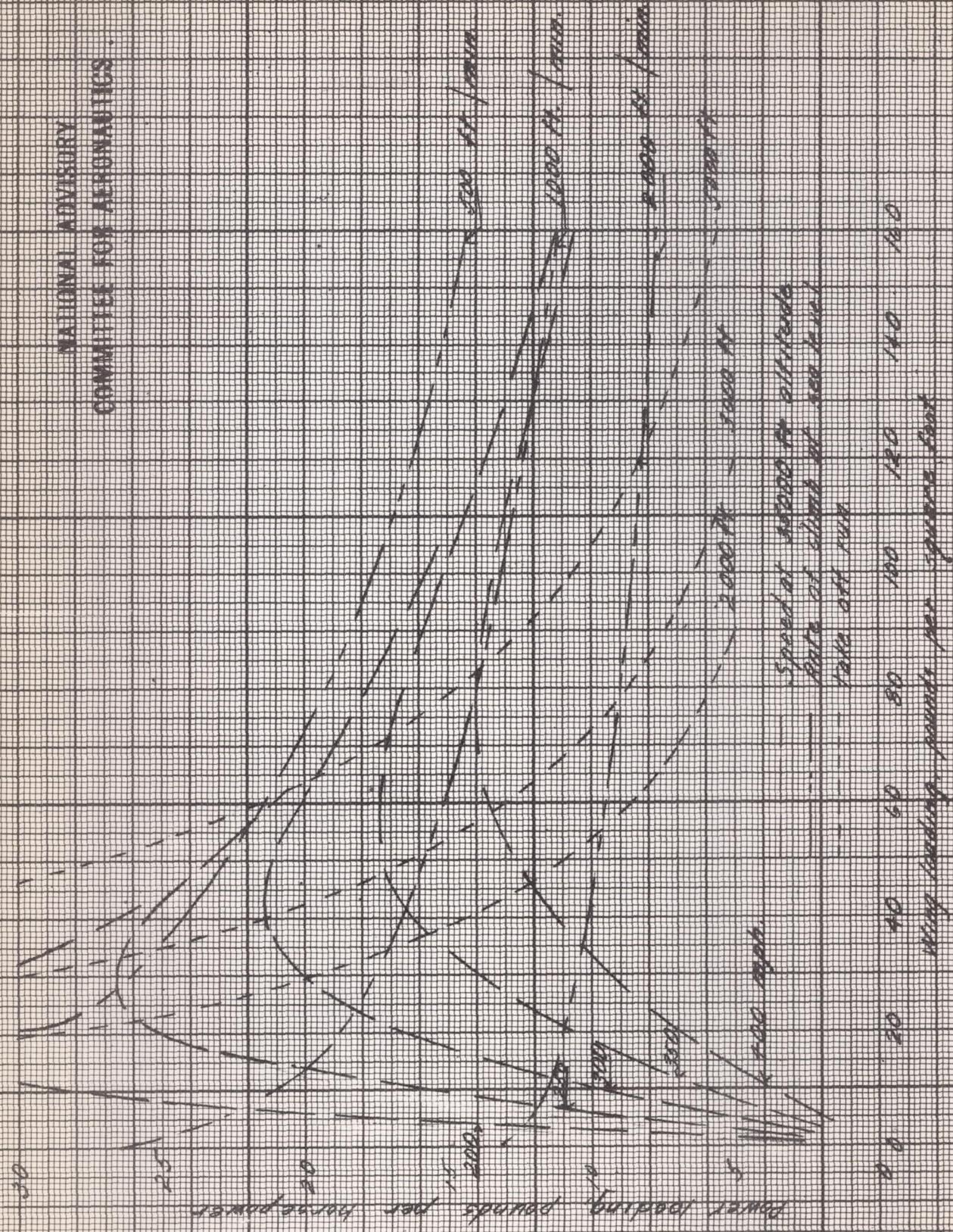


POWER LOADING, pounds per horsepower

0 20 40 60 80 100 120 140  
POWER PER HORSE-POWER

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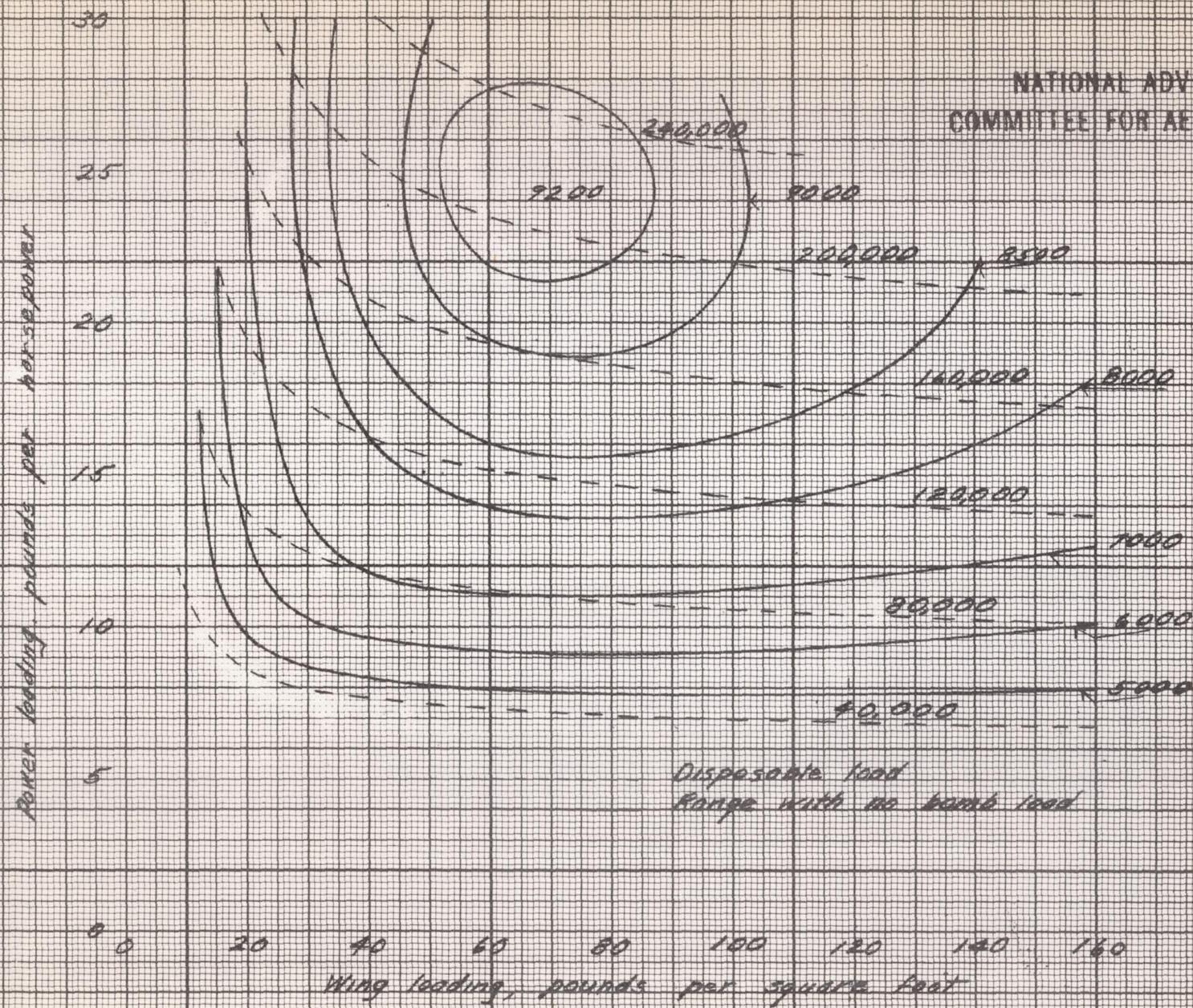


Figure 14(f). - Selection chart for bombers powered by six 3000-horsepower engines, part II.

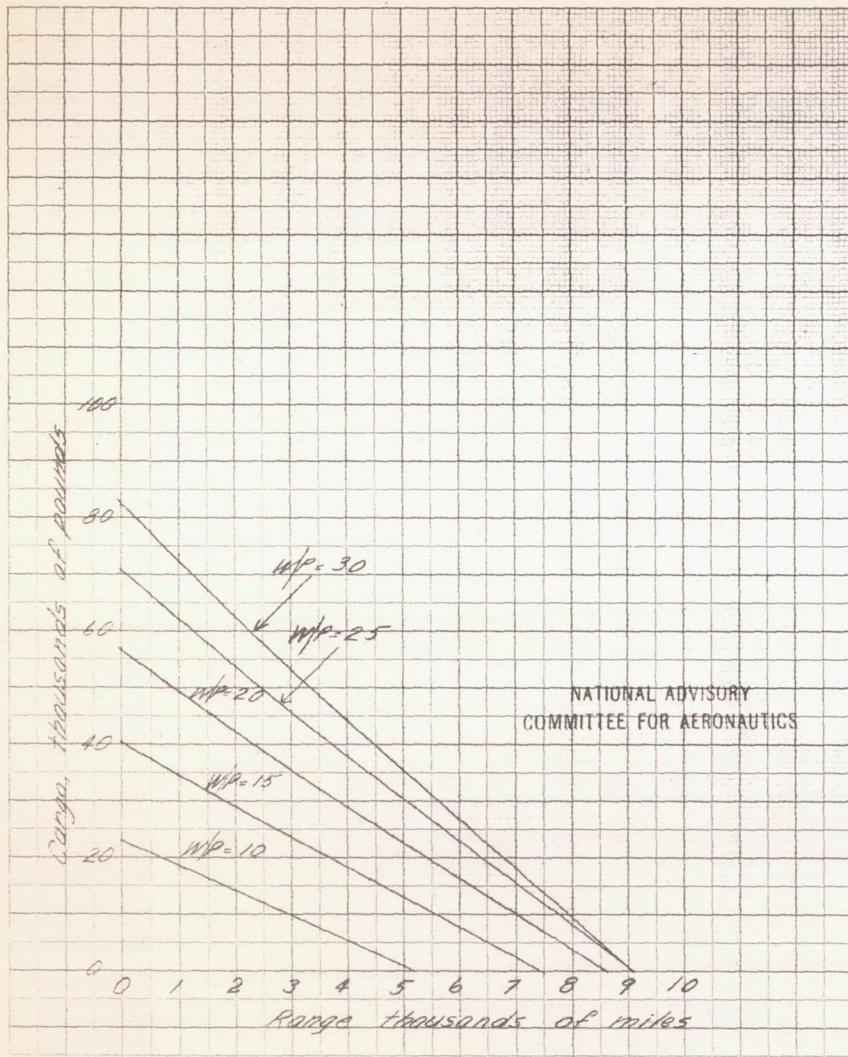


Figure 15(a). - Cargo capacity of bombers powered by two 3000-horsepower engines, 4000-foot take-off.

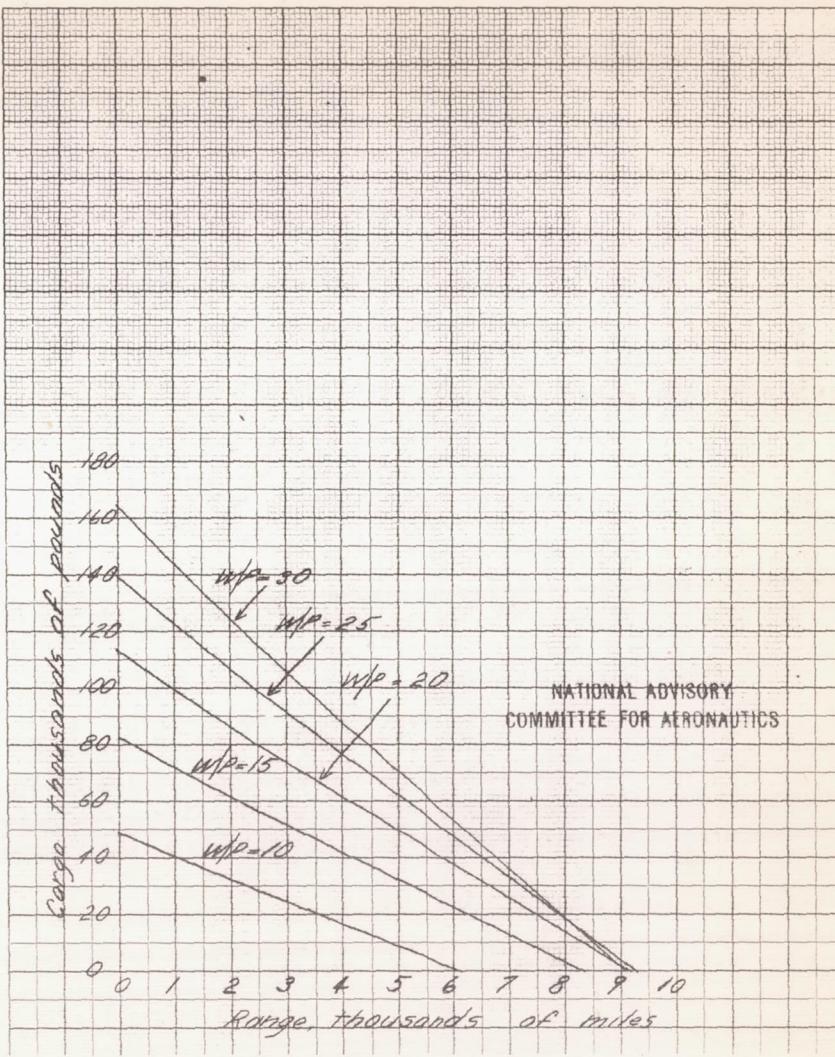


Figure 15(b). - Cargo capacity of bombers powered by four 3000-horsepower engines, 4000-foot take-off.

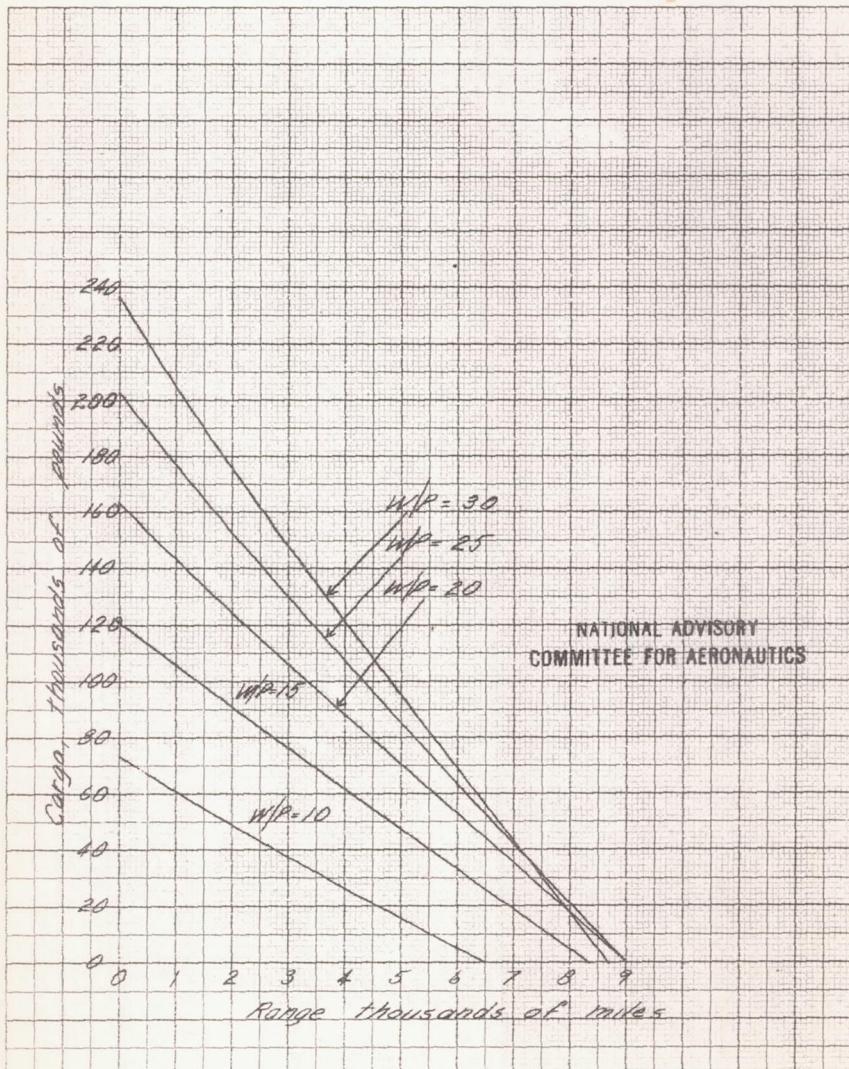


Figure 15(c). - Cargo capacity of bombers powered by six 3000-horsepower engines, 4000-foot take-off.

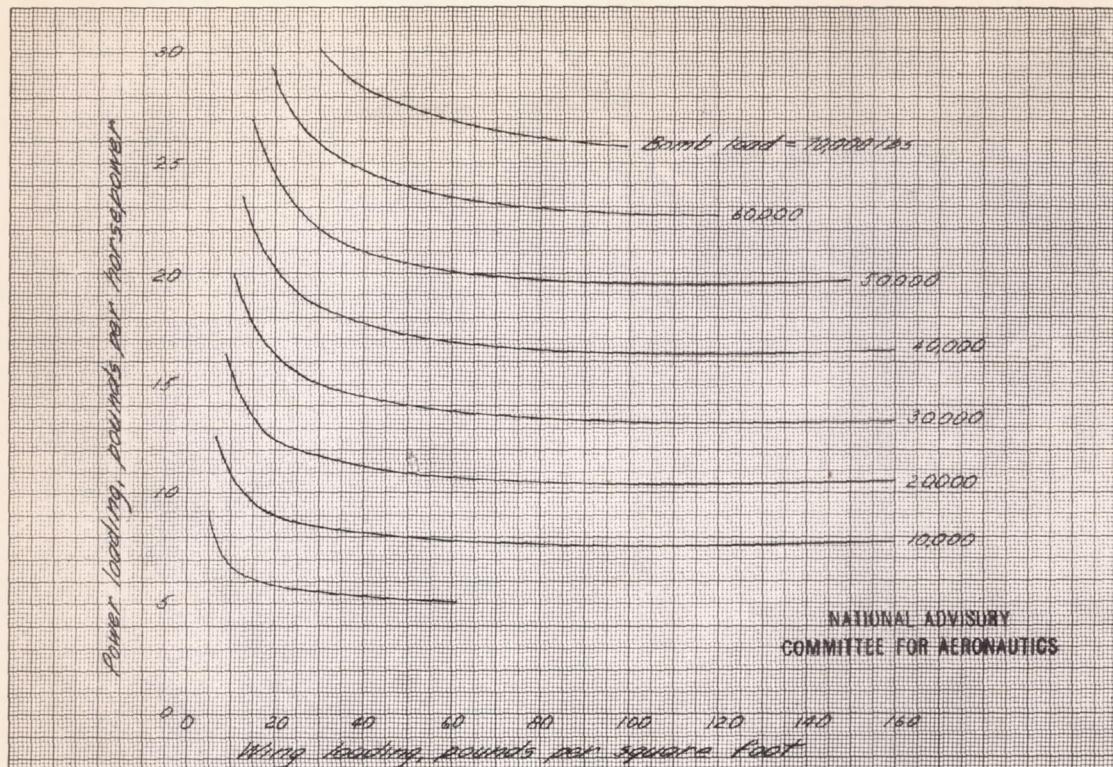


Figure 16(a). - Bomb capacity with two 3000-horsepower engines, 1000-mile range.

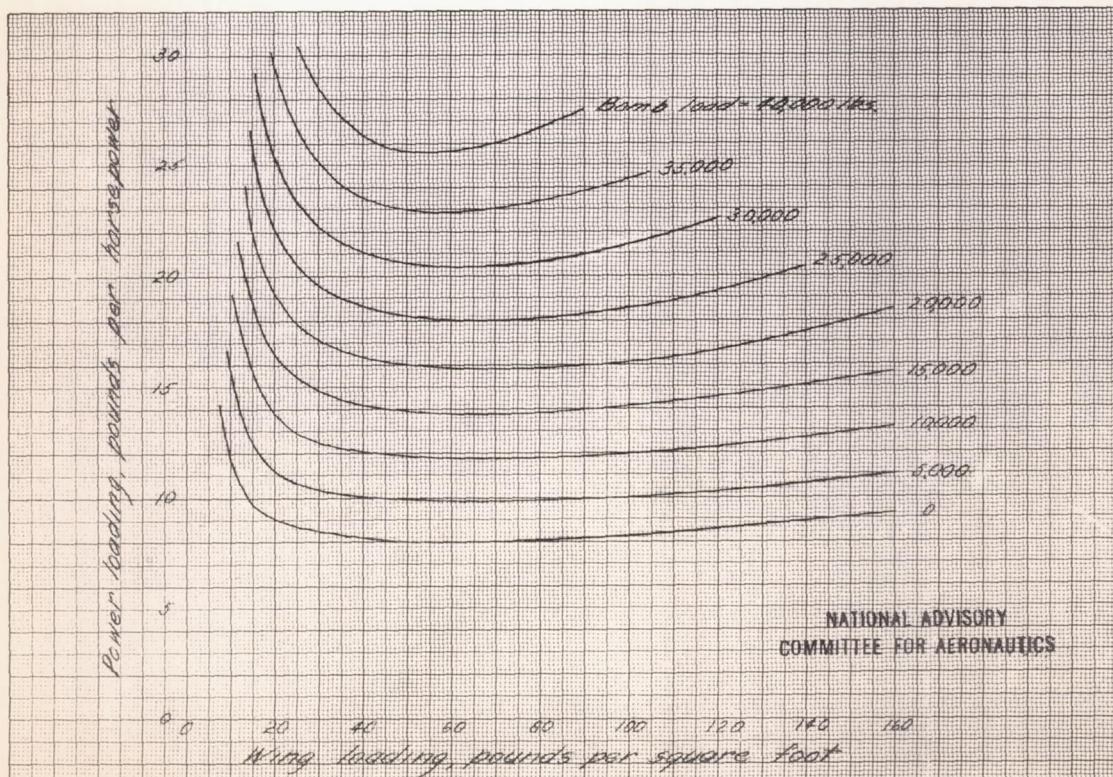


Figure 16(b). - Bomb capacity with two 3000-horsepower engines, 4000-mile range.

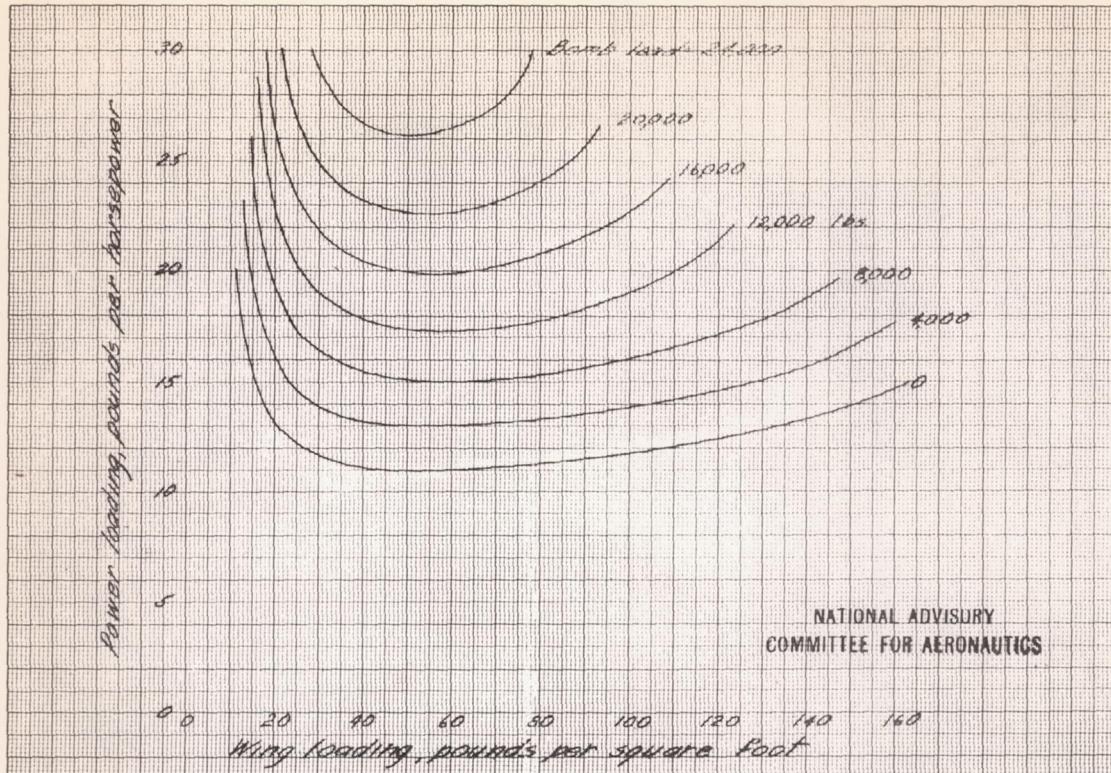


Figure 16(c). - Bomb capacity with two 3000-horsepower engines, 6000-mile range.

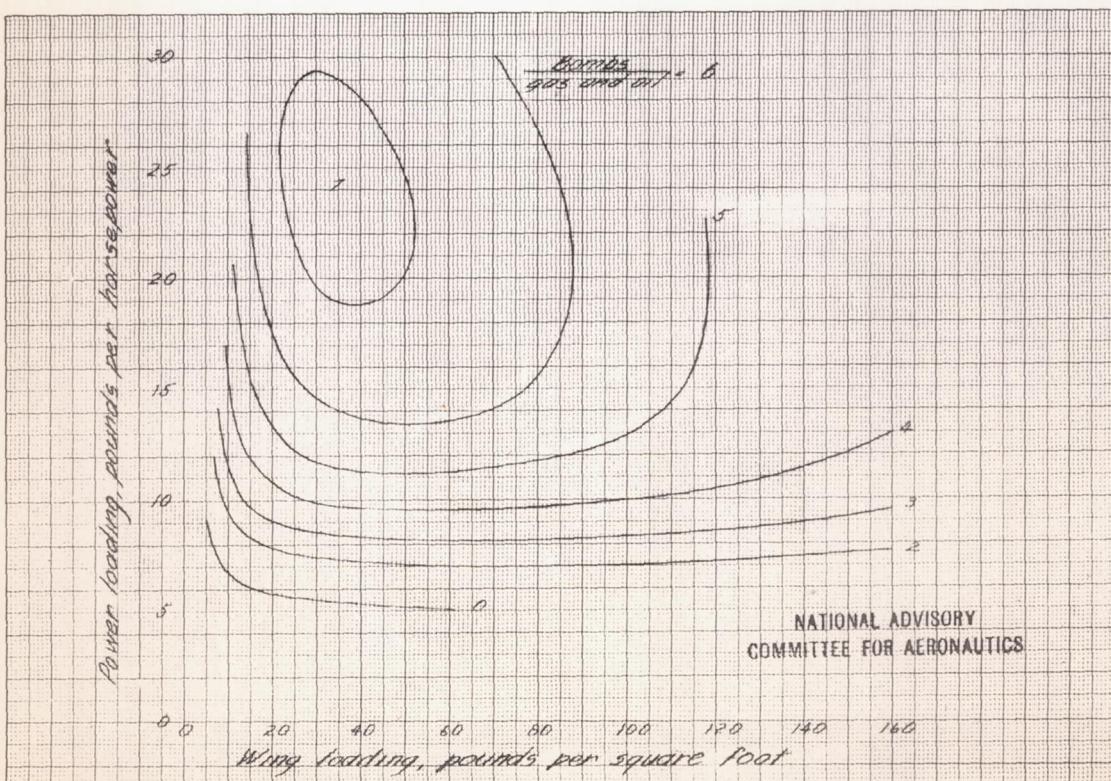


Figure 16(d). - Bombs/gas and oil with two 3000-horsepower engines, 1000-mile range.

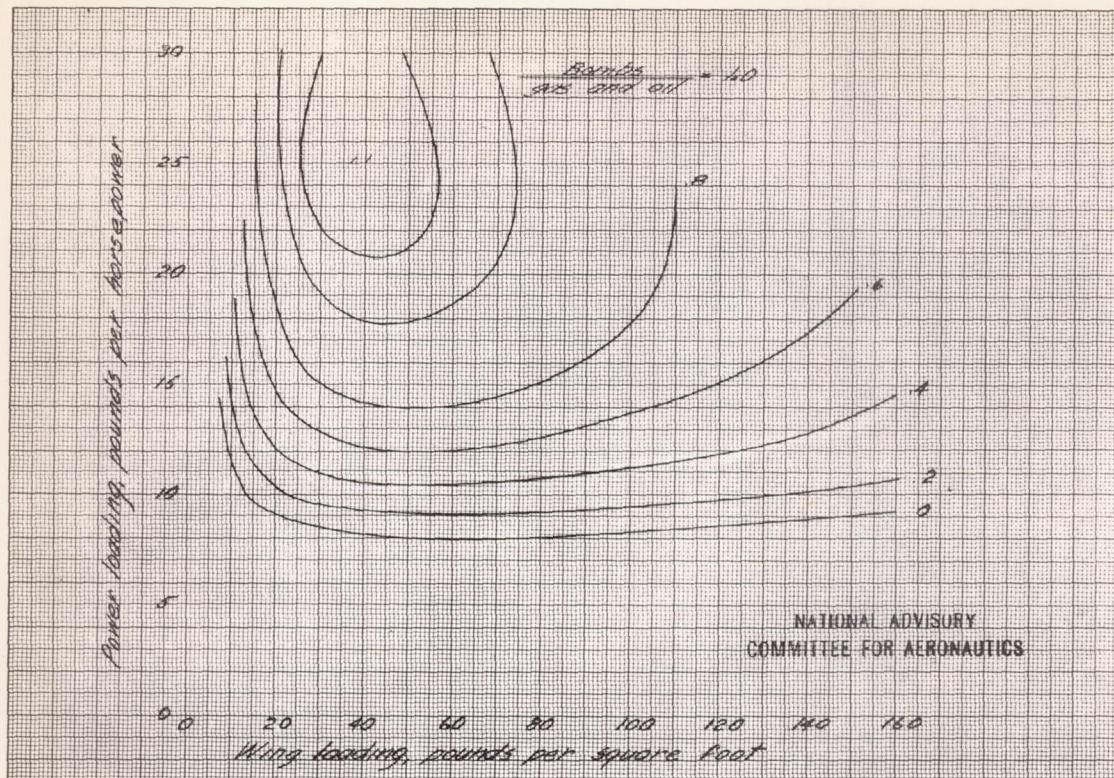


Figure 16(e). - Bombs/gas and oil with two 3000-horsepower engines, 4000-mile range.

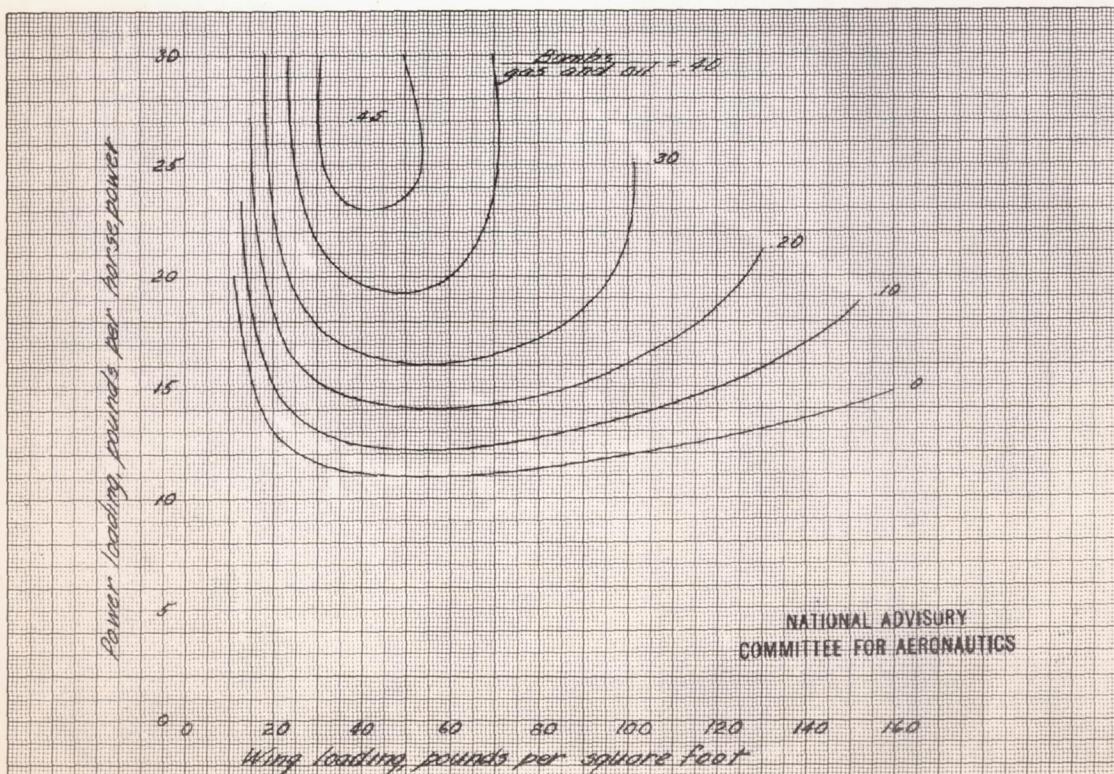


Figure 16(f). - Bombs/gas and oil with two 3000-horsepower engines, 6000-mile range.

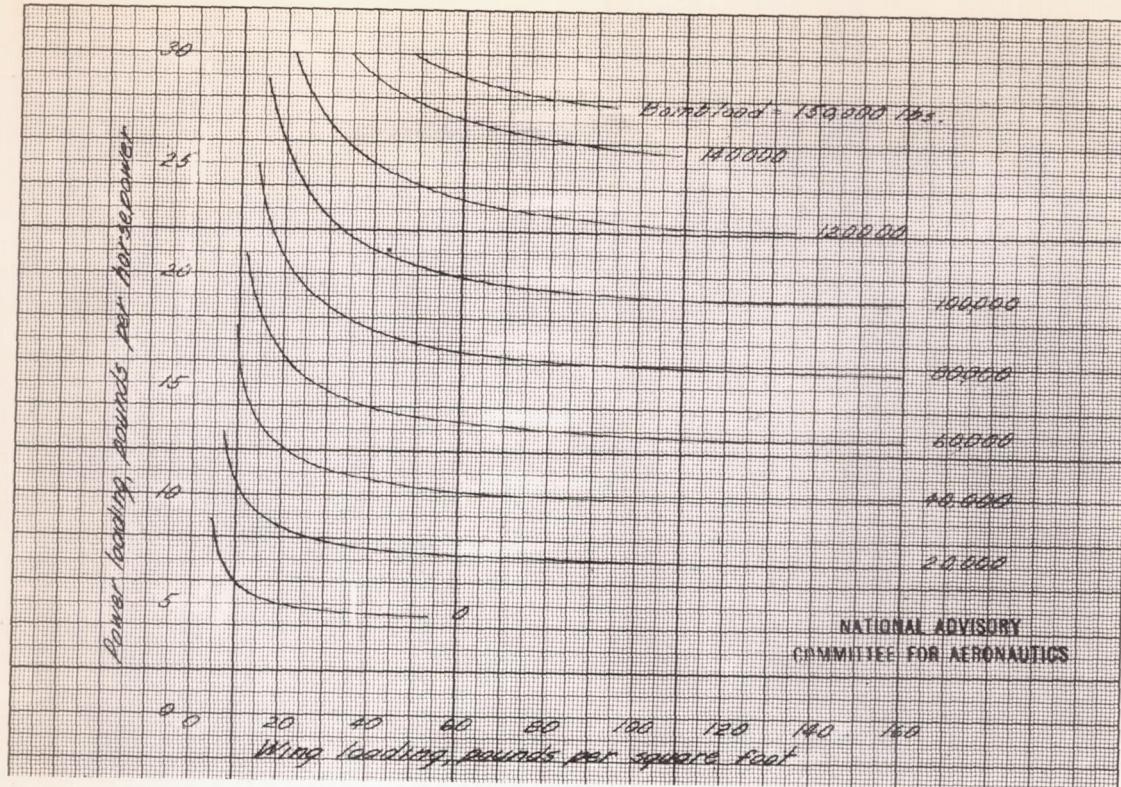


Figure 17(a). - Bomb capacity with four 3000-horsepower engines, 1000-mile range.

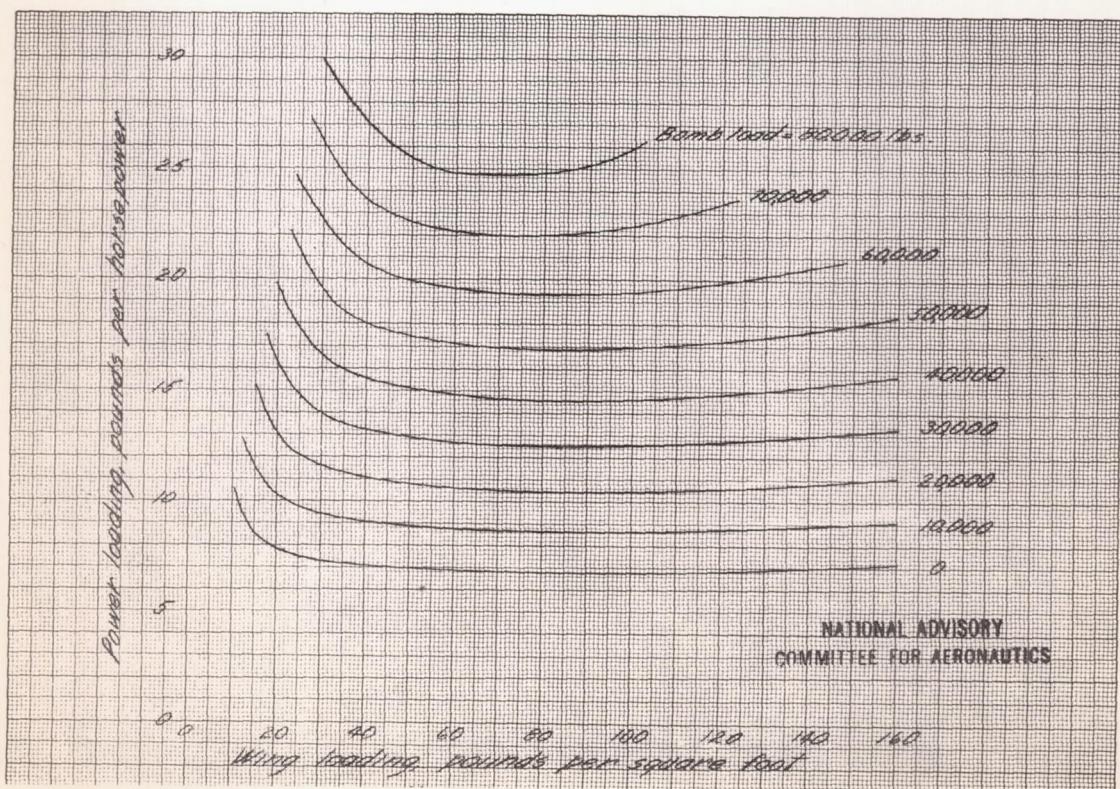


Figure 17(b). - Bomb capacity with four 3000-horsepower engines, 4000-mile range.

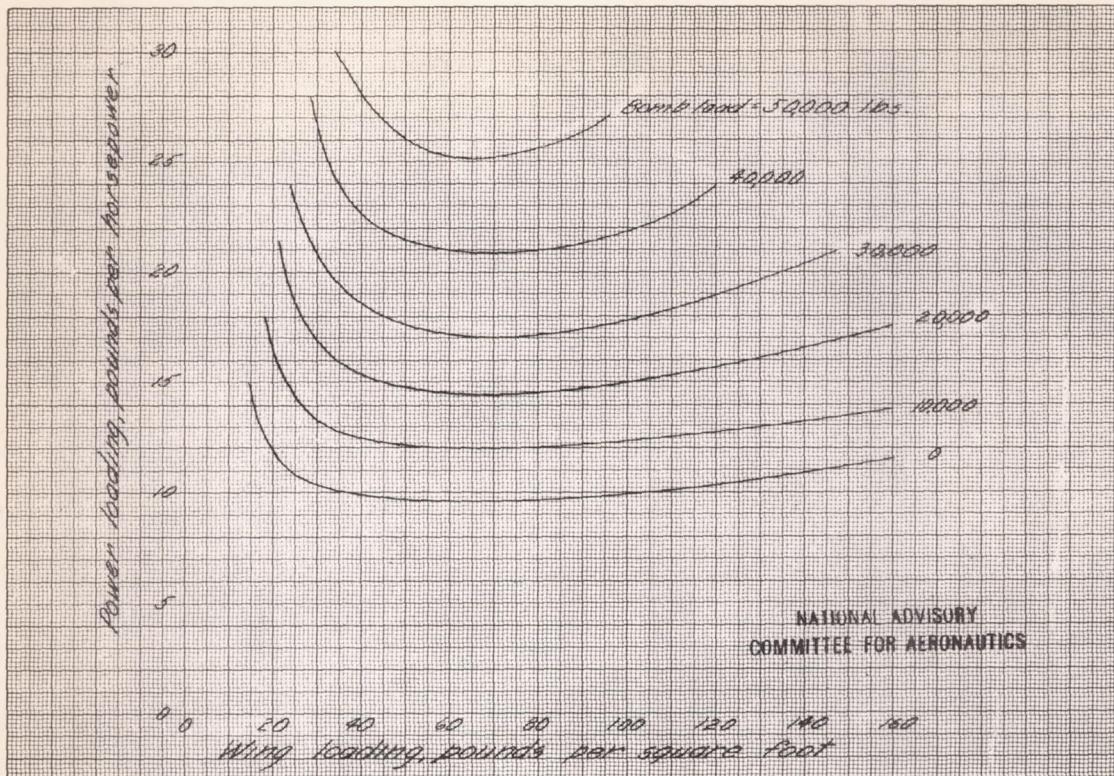


Figure 17(c). - Bomb capacity with four 3000-horsepower engines, 6000-mile range.

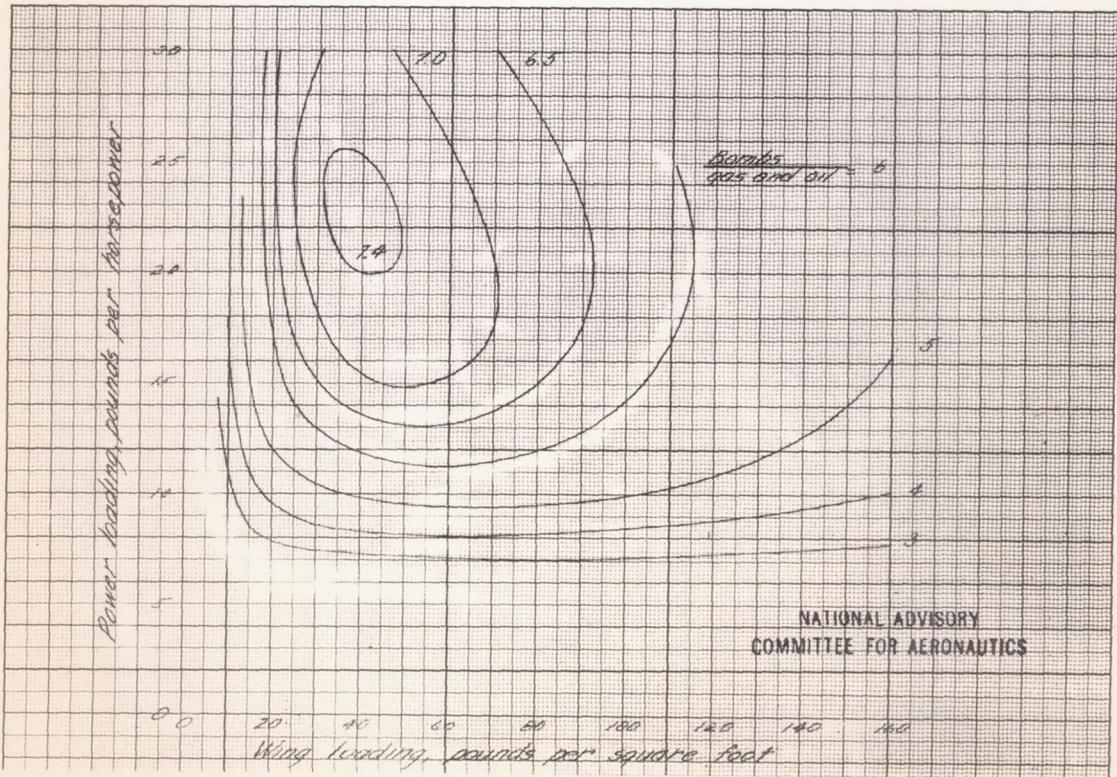


Figure 17(d). - Bombs/gas and oil with four 3000-horsepower engines, 1000-mile range.

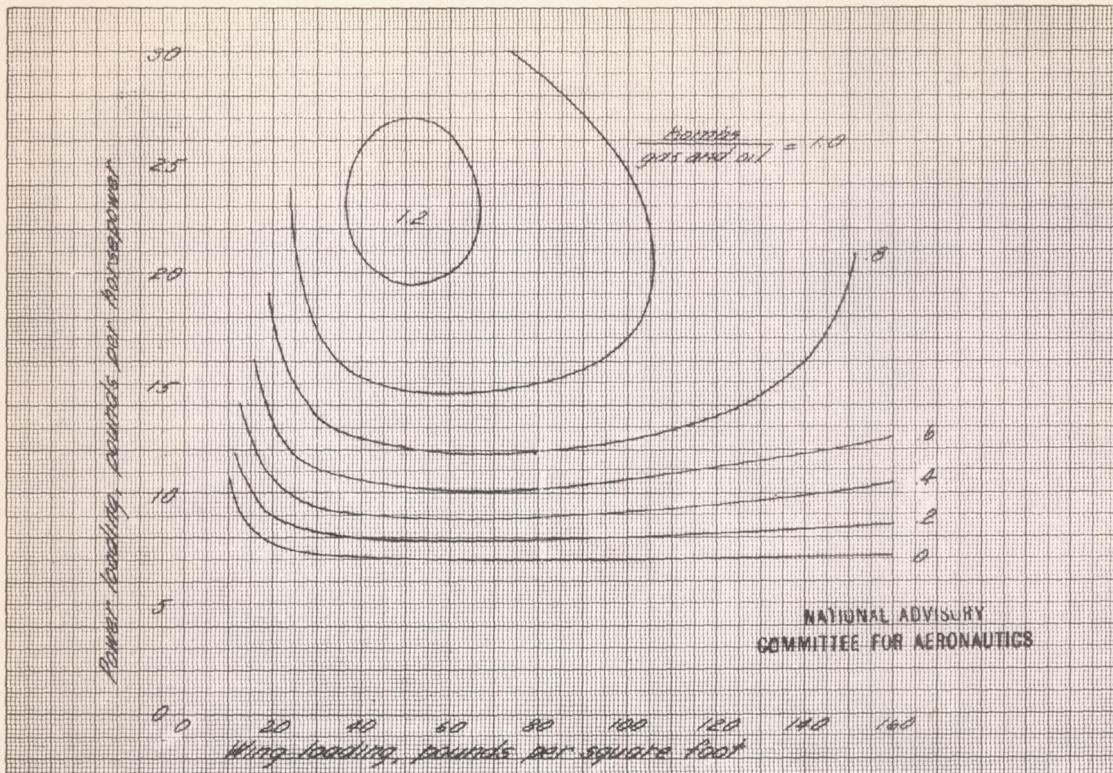


Figure 17(e). - Bombs/gas and oil with four 3000-horsepower engines, 4000-mile range.

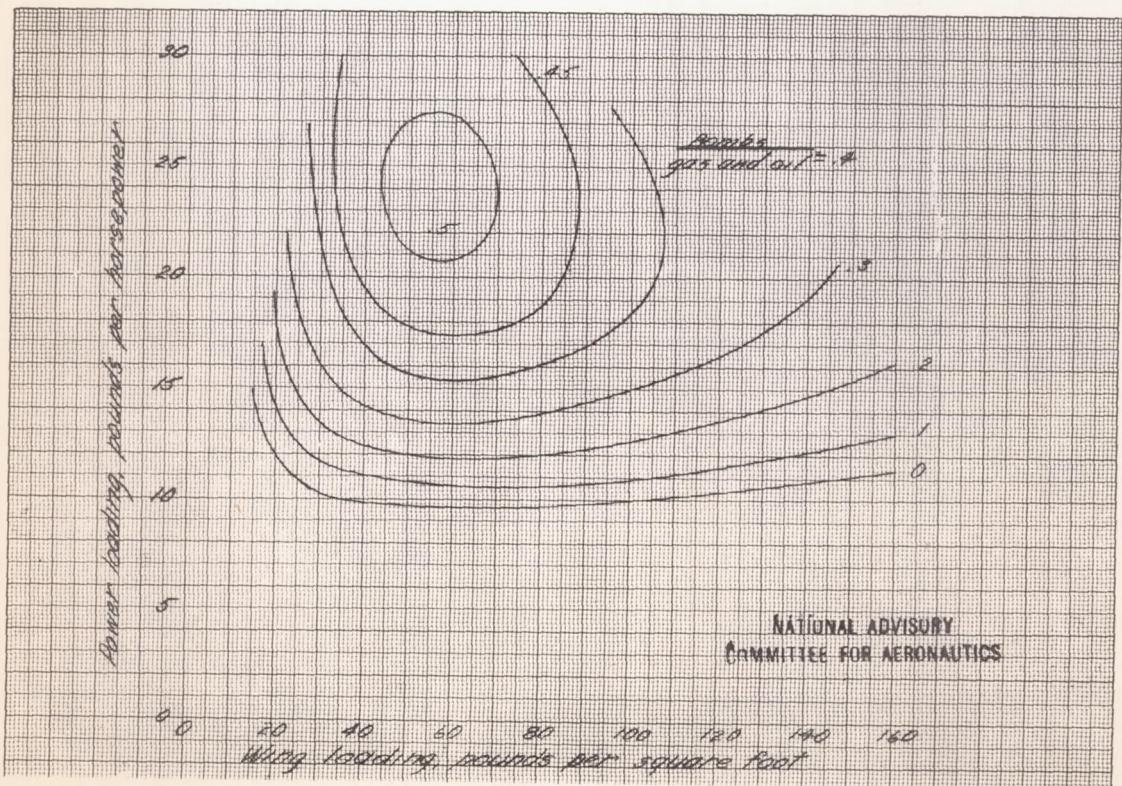


Figure 17(f). - Bombs/gas and oil with four 3000-horsepower engines, 6000-mile range.

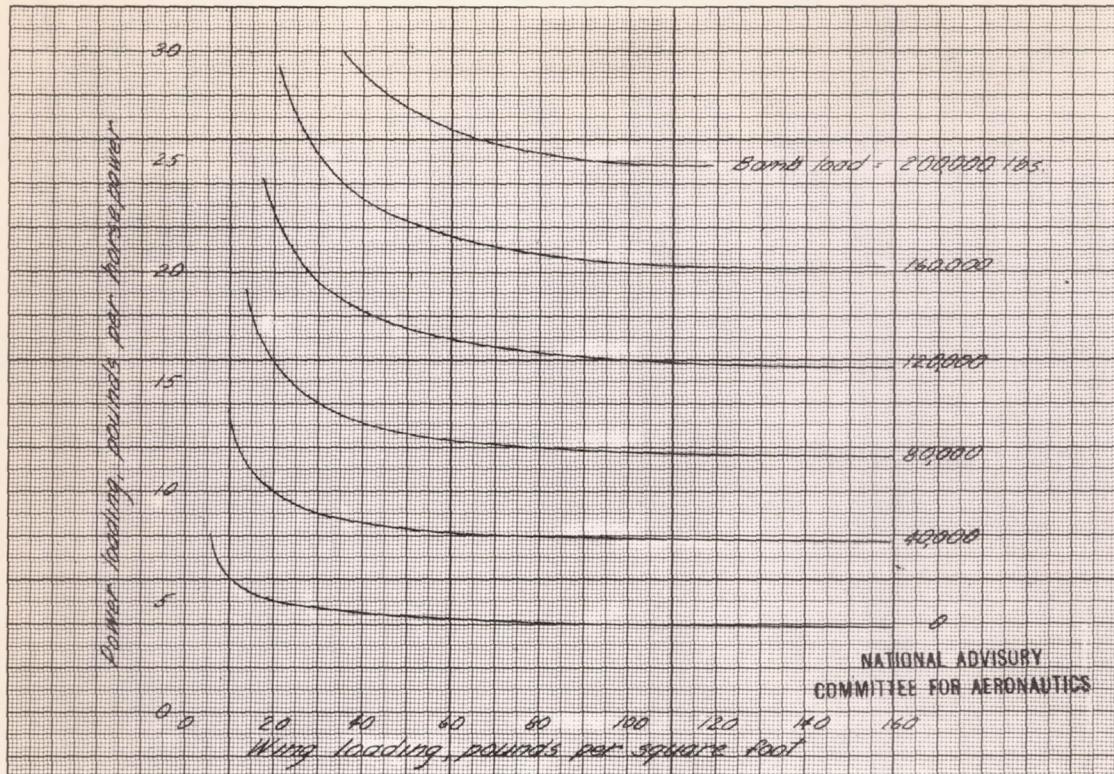


Figure 18(a). - Bomb capacity with six 3000-horsepower engines, 1000-mile range.

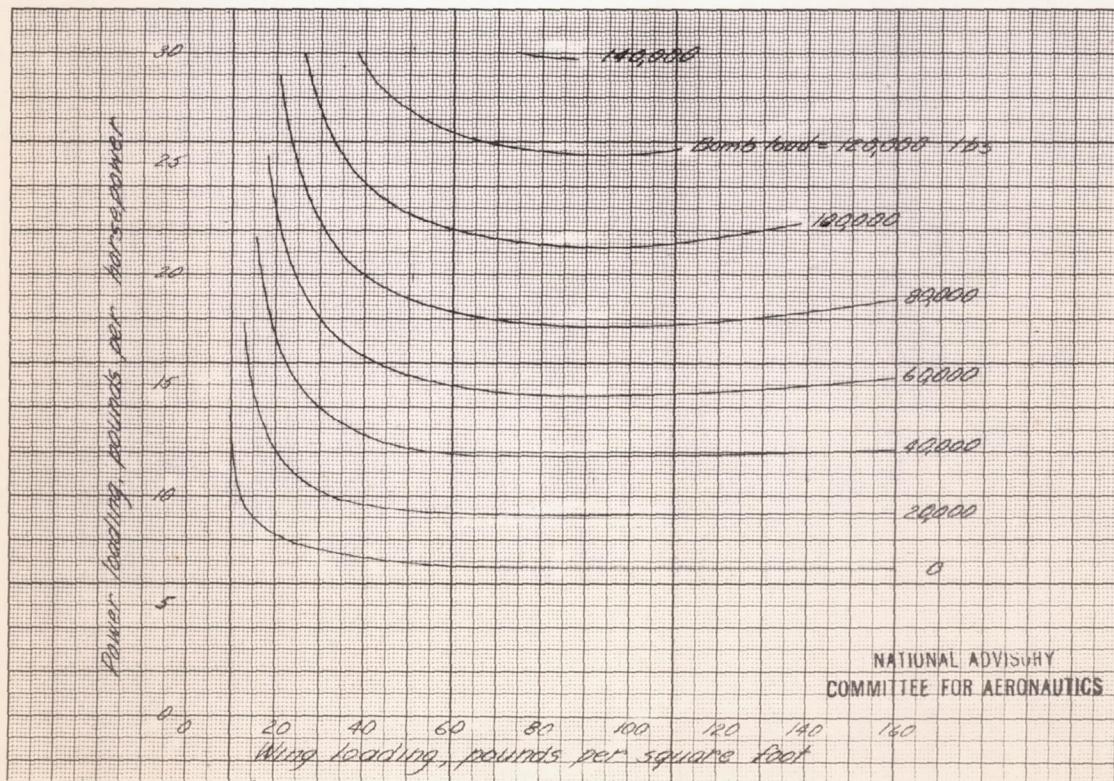


Figure 18(b). - Bomb capacity with six 3000-horsepower engines, 4000-mile range.

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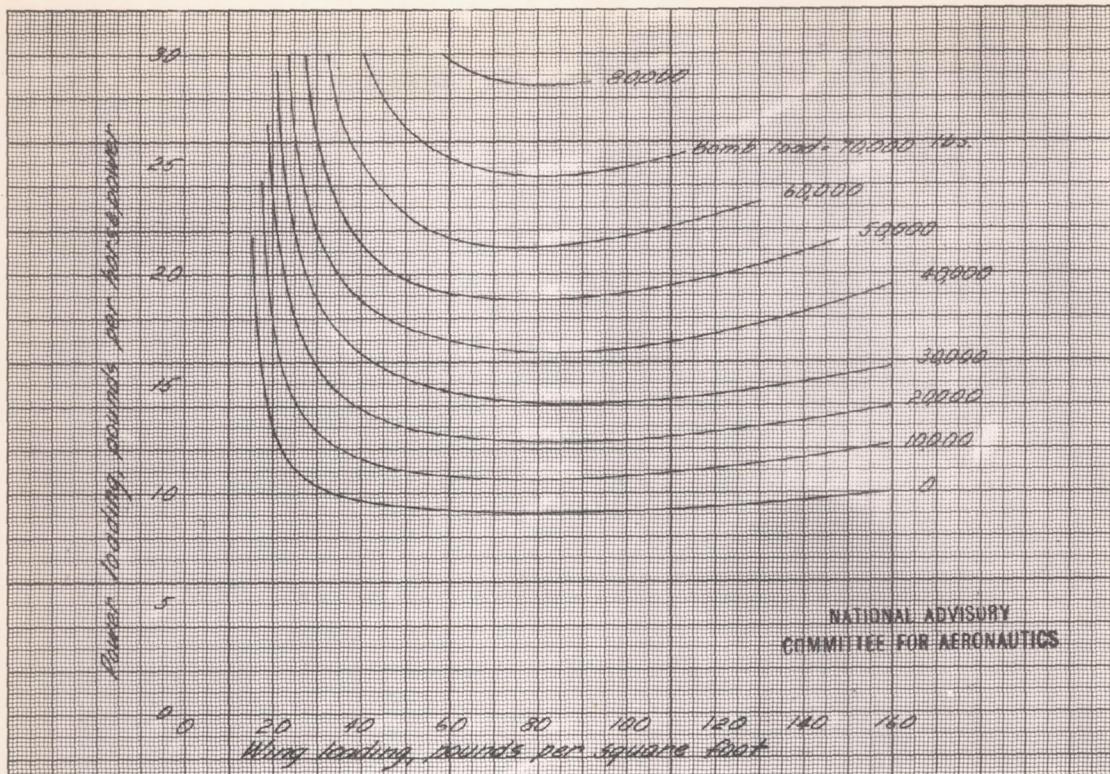


Figure 18(c). - Bomb capacity with six 3000-horsepower engines, 6000-mile range.

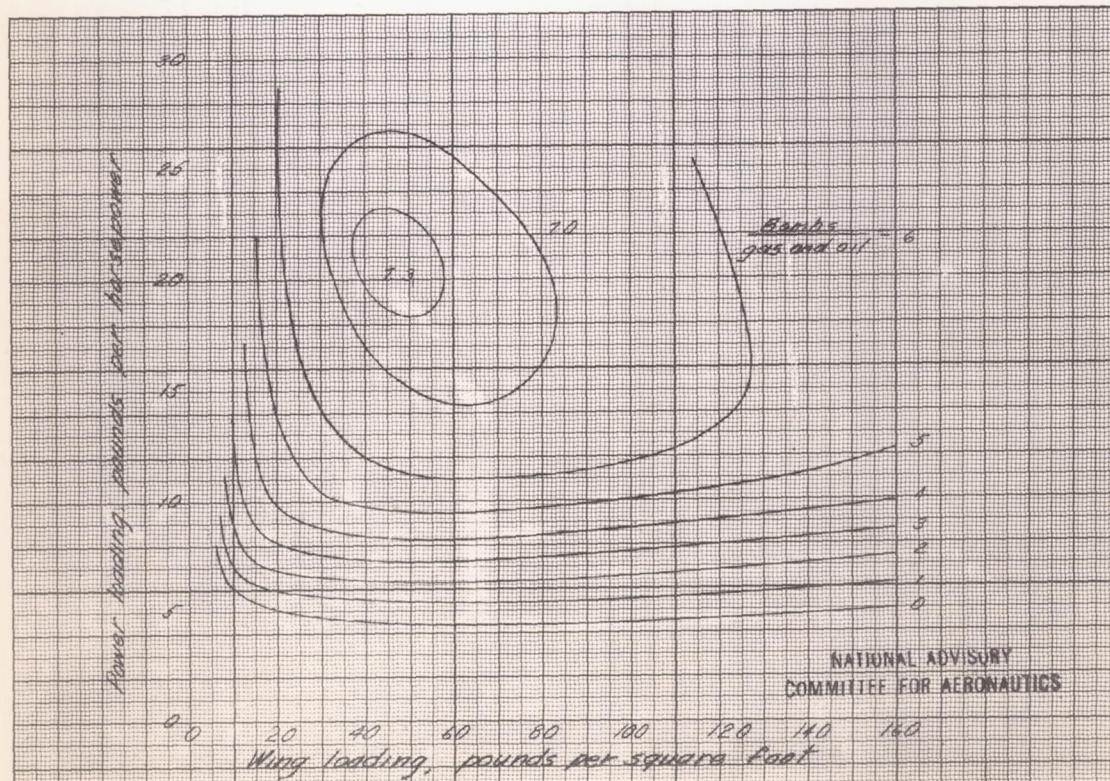


Figure 18(d). - Bombs/gas and oil with six 3000-horsepower engines, 1000-mile range.

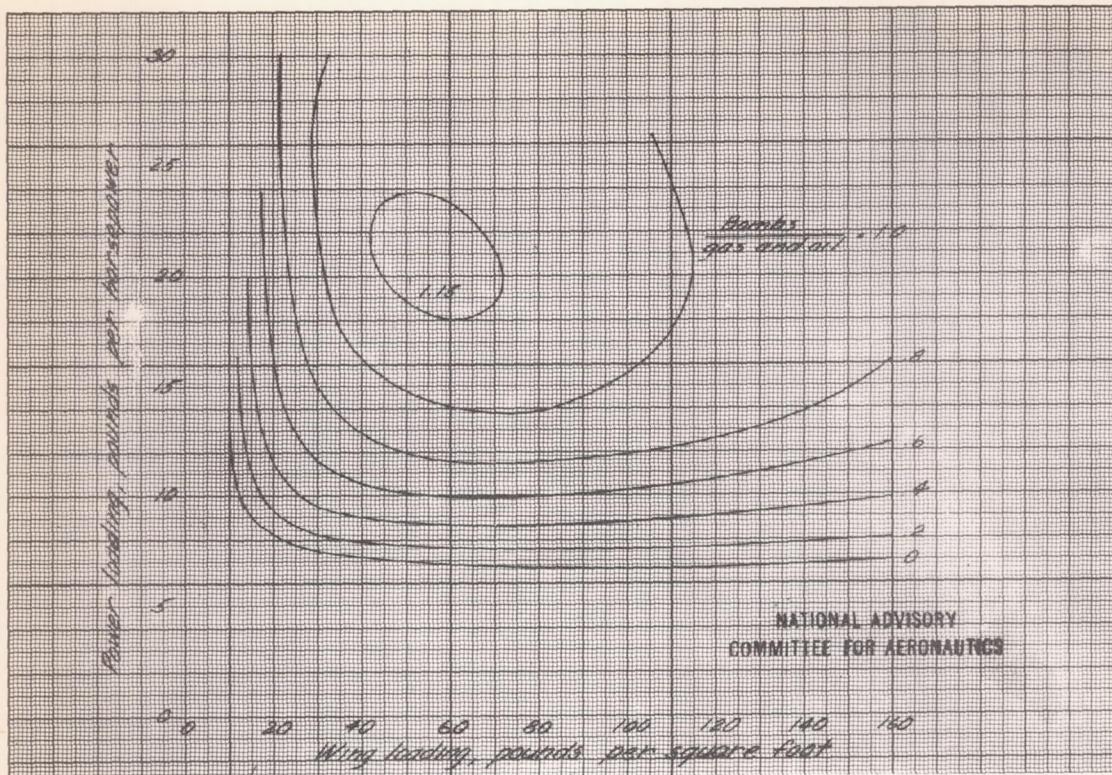


Figure 18(e). - Bombs/gas and oil with six 3000-horsepower engines, 4000-mile range.

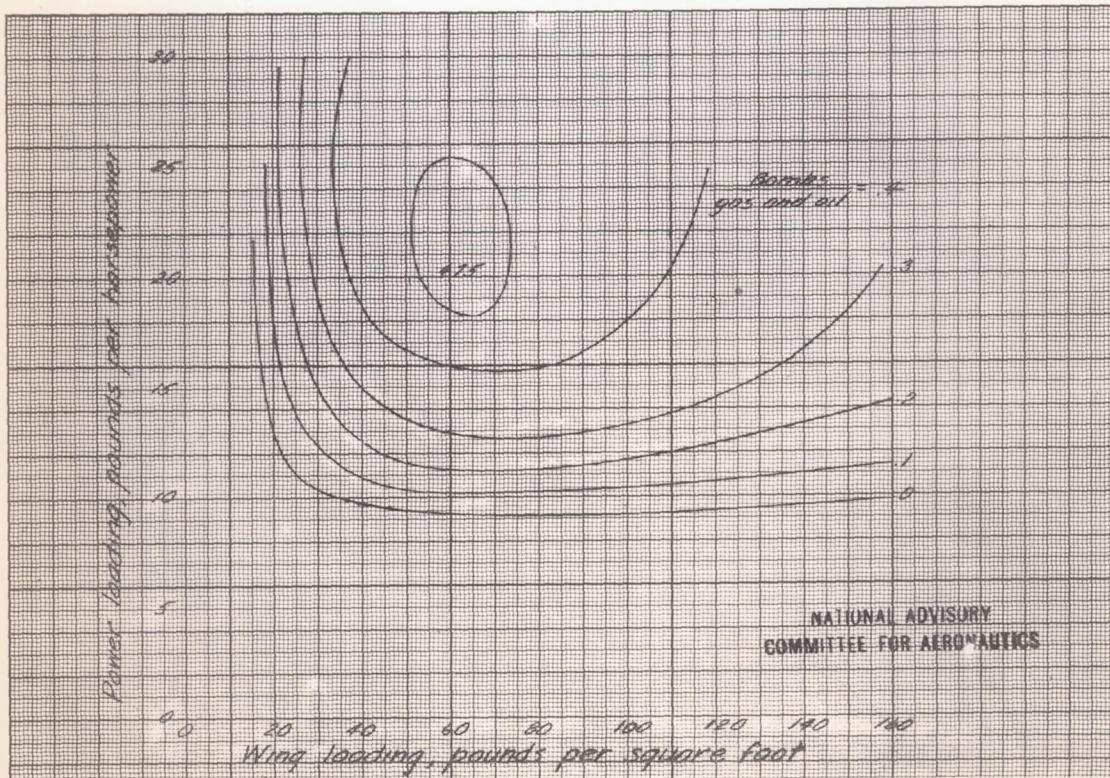


Figure 18(f). - Bombs/gas and oil with six 3000-horsepower engines, 6000-mile range.